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EXAMINER	
HANSEN, JONATHAN M	

ART UNIT	PAPER NUMBER
2886	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/713,212	SWINDAL, J. CHRISTIAN	
	Examiner	Art Unit	
	JONATHAN M. HANSEN	2886	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 February 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *14-26* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *14-26* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *17 November 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

Applicant's arguments filed 02/05/2008 have been fully considered but they are not persuasive.

In regards to the applicant's arguments to claims 14 and 20, that Osawa fails to disclose "a superluminescent device (SLD) that transmits a light beam having a longitudinal coherence length based on at least one optical parameter associated with one or more optical elements of the position determining system, wherein the longitudinal coherence length substantially eliminates ghost or spurious reflections from the one or more optical elements present during exposure of a pattern in a lithography tool", the Examiner respectfully disagrees.

It is first noted that the coherence of a light source is viewed as having two components: temporal (often referred to as longitudinal) coherence and spatial coherence. Wherein temporal (longitudinal) coherence is a measure of deviation in frequency from a nominal frequency and spatial coherence is a measure of the collimation of a beam. Therefore, Osawa is viewed as disclosing a superluminescent device (SLD) that transmits a light beam having a longitudinal coherence length.

Attention is now brought to column 6, lines 3-30 of Osawa, wherein the relationship between the spectral width of the light source and the spacing between the mask and wafer is disclosed. Coherence length (lc) of any light beam is given by the relation: $lc = \lambda^2/\Delta\lambda$, wherein λ is the wavelength of the light and $\Delta\lambda$ is the spectral width (i.e. full width at half maximum).

Also, the condition under which reflection lights from the mask and the wafer do not interfere with each other is that the coherence length is less than or equal to twice the optical path length or the spacing between the mask and the wafer (g). Therefore, through an arrangement of the relation given above, the condition necessary for preventing interference is that the spectral width of the light beam is greater than or equal to $\lambda^2/2g$. Therefore, a broader spectral width and a shorter wavelength prevent interference better. (column 6, lines 3-30) This translates to a very low coherence length, and, therefore, this very low coherence length is chosen to eliminate the ghost or spurious reflections. Osawa further discloses in column 8, lines 54-62, said spectral width can be controlled in order to reduce the coherency of the light and eliminate spurious reflections.

Therefore, Osawa is understood to disclose an SLD that transmits a light beam having a longitudinal coherence length that is based upon the spacing between the mask and wafer (applicant's one optical parameter associated with one or more optical elements of the position determining system) as discussed above.

In regards to the arguments of claims 17 and 22, that Alphonse does not resolve the deficiencies of Osawa, they are now moot in view of the above description of the prior art.

In regards to the applicant's arguments to claim 26, that "there is no teaching or suggestion in Osawa that those alleged unwanted reflections may be used independently of beams 47' and 47" to produce a control signal related to the determined position of the alignment mark on a wafer", the Examiner respectfully disagrees.

Attention is brought to column 4, lines 1-13, wherein an alignment system for obtaining positional deviation from lights from the zone plates on the mask and wafer, respectively, are imaged independently of each other.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims **14-16, 18-21 and 23-26** are rejected under 35 U.S.C. 103(a) as being unpatentable over **US Pat. 5,155,370 to Osawa et al.**

In regards to claim **14**, Osawa discloses a position determining system that measures a position of an alignment mark on a substrate comprising:

a superluminescent device (SLD) that transmits a light beam having a longitudinal coherence length based on at least one optical parameter associated with one or more optical elements of the position determining system, wherein the longitudinal coherence length substantially eliminates ghost or spurious reflections from the one or more optical elements present during exposure of a pattern in a lithography tool (see above discussion and col. 6, ll. 3-30 and col. 8, ll. 54-62);

Light is sent from a source (10) and through a half mirror (74) to be sent to a mask/wafer alignment system in an exposure apparatus.

In one embodiment of the invention, the light source is a super luminescent diode, which is a type of super luminescent device (column 9, line 64-66).

a lens system that directs the light beam to be diffracted from the alignment mark, the diffracted light causing ghost or spurious reflections through its interaction with the lens system;

Light is focused at a point (78) by a condensing lens (76). The light illuminates a mask alignment pattern (3M) on a mask (M) and a wafer alignment pattern (4W) on a wafer (4) (column 3, lines 28-34 and as discussed above).

a sensor configured to use the diffracted light to determine a position of the alignment mark to produce a control signal related to the determined position;

Light reflects from the alignment marks and is gathered by lens (78) and another lens (80) and sent to a detector (8). Further, unwanted light (47") is detected by the detector and is removed because it leads to a decrease in the signal-to-noise ratio (column 4, lines 31-43). This sensor gathers information about the deviation in position of the two spots formed by the two subsequent alignment marks (column 3, lines 34-39). The light beams diffract off the alignment marks (Figure 1B) (column 3, lines 46-59).

and a positioning system configured to align the substrate to receive a subsequent pattern based on the control signal,

An output from the detector (8) is sent to a control circuit (84) which actuates a driving mechanism (64) to align the mask and the wafer (column 3, lines 40-42).

However, Osawa fails to explicitly disclose the limitation wherein the positioning system is configured to use the control signal to substantially reduce the ghost or spurious reflections.

As discussed above, unwanted light reflections would be generated by diffracted light 47' and such unwanted light could be removed from the detector signal to increase the signal-to-noise ratio. Osawa further discloses that the distribution of the signal light and unwanted light changes greatly with small changes in the spacing between the mask and the wafer (col. 5, ll. 33-55).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify positioning system of Osawa to reduce the ghost or spurious reflections for the advantage of improving the position detecting precision, as taught by Osawa.

In regards to claim **15**, the SLD is configured to produce the coherence length of the light beam that substantially eliminates interference between at least one of ghost or spurious reflections caused by the lens system and the diffracted light beam. Typically, light from a source passing through and reflected by alignment patterns on a mask and a wafer have diffraction light (47") from the mask alignment pattern that interferes with the alignment signal light (47'), as shown in Figure 2 below (column 4, lines 31-39).

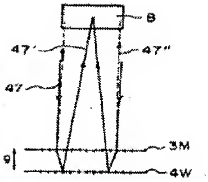

FIG. 2

The interference signal from the superposing of the unwanted diffraction light (47") and the alignment signal light (47') is illustrated below in Figure 3B. This signal shows a lot of randomly changing interference noise. (column 3, lines 46-51) This unwanted diffraction light represents ghost or spurious reflections.

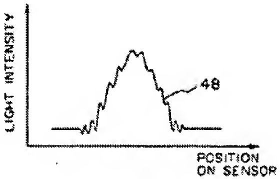

FIG. 3B

In order to get rid of this noise, both the signal and the unwanted light have to be completely incoherent (i.e. the degree of coherency of the beams diffracted from the mask alignment mark and the wafer alignment mark is zero). The interference pattern resulting from this is illustrated below in Figure 3C. (column 5, lines 55-64)

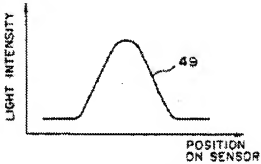

FIG. 3C

Coherence length lc of any light beam is given by the relation: lc = $\lambda^2/\Delta\lambda$, Wherein λ is the wavelength of the light and $\Delta\lambda$, is the spectral width (i.e. full width at half maximum). Also, the condition under which reflection lights from the mask and the wafer do not interfere with each other is that the coherence length is less than or equal to twice the optical path length or the spacing between the mask and the wafer, g. Therefore, through an arrangement of the relation given above, the condition necessary for preventing interference is that the spectral width of the light beam is greater than or equal to $\lambda^2/2g$. Therefore, a broader spectral width and a shorter wavelength prevent interference better. (column 6, lines 3-30) This translates to a very low coherence length, and, therefore, this very low coherence length is chosen to eliminate the ghost or spurious reflections.

Regarding claim **16**, the SLD is configured to produce a coherence length of the light beam that is less than a smallest distance between first and second ones of the lenses in the lens system. The coherence length of the SLD used is 60 microns (column 10, lines 13-18). The distance between the two lenses (76 and 80) of the lens system is greater than 60 microns.

Regarding claim **18**, the sensor is configured to determine the position of the alignment mark using interferometry. The intensity of the interference pattern of the invention is illustrated in Figure 3C above. (column 4, lines 43-45)

Regarding claim **19**, the SLD is configured to produce the coherence length of the light beam that is about 0.5 mm or less. The coherence length of the SLD is 60 microns. (column 10, lines 13-18)

In regards to claim **20**, Osawa discloses a position measuring method that measures a position of an alignment mark on a substrate comprising:

determining a longitudinal coherence length for superluminescent light based on at least one optical parameter associated with one or more optical elements of a position determining system, wherein the longitudinal coherence length substantially eliminates ghost or spurious reflections from the one or more optical elements present during exposure of a pattern in a lithography tool (see above discussion and col. 6, ll. 3-30 and col. 8, ll. 54-62);

generating and transmitting super luminescent light having a coherence length;

Light is sent from a source (10) and through a half mirror (74) to be sent to a mask/wafer alignment system in an exposure apparatus. In one embodiment of the invention, the light source is a super luminescent diode, which is a type of super luminescent device (column 9, line 64-66).

directing the super luminescent light to be diffracted from the alignment mark using a lens system;

Light is focused at a point (78) by a condensing lens (76). The light illuminates a mask alignment pattern (3M) on a mask (M) and a wafer alignment pattern (4W) on a wafer (4) (column 3, lines 28-34).

diffracting the super luminescent light from the alignment mark to produce +/- first order diffracted beams;

directing the +/- first order diffracted beams onto a combining element using the lens system, the diffracted light causing ghost or spurious reflections through its interaction with the lens system;

combining the +/- first order diffracted beams using the combining element;

determining a position of the alignment mark based on an interference pattern generated from the combining step;

Light reflects from the alignment marks and is gathered by lens (78) and another lens (80) and sent to a sensor (8). This sensor gathers information about the deviation in position of the two spots formed by the two subsequent alignment marks. (column 3, lines 34-39) The sensor represents a combining element, since this is where the two signals are gathered and combined to create a signal about the positional deviation between the alignment of the mask and the wafer. The light beams diffract off the alignment marks (Figure 1B and 3C). (column 3, lines

46-68) These diffracted light beams would include +/- first order diffracted beams. The mask is viewed as a part of the lens system and the wafer is viewed as the substrate.

generating a control signal based on the determined position; and positioning the substrate to properly align the substrate to receive a subsequent pattern based on the control signal,

An output from the detector (8) is sent to a control circuit (84) which actuates a driving mechanism (64) to align the mask and the wafer. (column 3, lines 40-42)

However, Osawa fails to explicitly disclose the limitation wherein the positioning system is configured to use the control signal to substantially reduce the ghost or spurious reflections.

As discussed above, unwanted light reflections would be generated by diffracted light 47' and such unwanted light could be removed from the detector signal to increase the signal-to-noise ratio. Osawa further discloses that the distribution of the signal light and unwanted light changes greatly with small changes in the spacing between the mask and the wafer (col. 5, ll. 33-55).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify positioning system of Osawa to reduce the ghost or spurious reflections for the advantage of improving the position detecting precision, as taught by Osawa.

In regards to claim **21**, the generating step comprises using a super luminescent device (SLD) to create super luminescent light (column 9, line 64 to column 6, line 6).

Regarding claim **23**, the coherence length of the super luminescent light is about 0.5 mm or less. The coherence length of the SLD is 60 microns (column 10, lines 13- 18).

In regards to claim **24**, the coherence length of the light beam is less than a smallest distance between first and second ones of the lenses in the lens system. The coherence length of the SLD used is 60 microns (column 10, lines 13-18). The distance between the two lenses (76 and 80) of the lens system is greater than 60 microns.

Regarding claim **25**, wherein the coherence length of the light beam is less than a smallest thickness of one of the lenses in the lens system. If the lens was of a thickness of greater than the coherence length of the light beam, the beam would spread out more upon being sent through the lens to the alignment marks, introducing a decrease in signal to noise ratio of the light beams (column 6, lines 51-63).

In regards to claim **26**, Osawa discloses a position determining system that measures a position of an alignment mark on a substrate comprising:

a super luminescent device (SLD) that transmits a light beam;

Light is sent from a source (10) and through a half mirror (74) to be sent to a mask/wafer alignment system in an exposure apparatus.

In one embodiment of the invention, the light source is a super luminescent diode, which is a type of super luminescent device (column 9, line 64-66).

a lens system that directs the light beam to be diffracted from the alignment mark, the diffracted light causing ghost or spurious reflections through its interaction with the lens system;

Light is focused at a point (78) by a condensing lens (76). The light illuminates a mask alignment pattern (3M) on a mask (M) and a wafer alignment pattern (4W) on a wafer (4) (column 3, lines 28-34 and as discussed above).

a sensor configured to use the diffracted light to determine a position of the alignment mark to produce a control signal related to the determined position;

Light reflects from the alignment marks and is gathered by lens (78) and another lens (80) and sent to a detector (8). Further, unwanted light (47") is detected by the detector and is removed because it leads to a decrease in the signal-to-noise ratio (column 4, lines 31-43). This sensor gathers information about the deviation in position of the two spots formed by the two subsequent alignment marks (column 3, lines 34-39). The light beams diffract off the alignment marks (Figure 1B) (column 3, lines 46-59).

and a positioning system configured to align the substrate to receive a subsequent pattern based on the control signal,

An output from the detector (8) is sent to a control circuit (84) which actuates a driving mechanism (64) to align the mask and the wafer (column 3, lines 40-42).

However, Osawa fails to explicitly disclose the limitation wherein the positioning system is configured to use the control signal to substantially reduce the ghost or spurious reflections.

As discussed above, unwanted light reflections would be generated by diffracted light 47' and such unwanted light could be removed from the detector signal to increase the signal-to-

noise ratio. Osawa further discloses that the distribution of the signal light and unwanted light changes greatly with small changes in the spacing between the mask and the wafer (col. 5, ll. 33-55).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify positioning system of Osawa to reduce the ghost or spurious reflections for the advantage of improving the position detecting precision, as taught by Osawa.

3. Claims **17 and 22** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Osawa,** in view of **US Pat. 4,821,277 to Alphonse et al**.

Regarding claims **17 and 22**, Osawa does not disclose the specifics of the SLD used in the system or method disclosed.

Alphonse discloses a super luminescent device that presents the specifics behind the technology of the device. The SLD of Alphonse comprises a laser diode having at least one anti-reflective surface to generate the super luminescent light (column 1, lines 45-47).

Therefore, it would have been obvious to one or ordinary skill in the art at the time of the invention to use the SLD of Alphonse in the device and method of Osawa since the technology of the SLD presented is well known in the art and provides the advantages of a high power, low coherence light source.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JONATHAN M. HANSEN whose telephone number is (571)270-1736. The examiner can normally be reached on Monday through Friday 9:30AM to 6:00PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tarifur Chowdhury can be reached on 571-272-2287. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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